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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/590,462	06/09/2000	Marco Racanelli	02SPE133P	1783
25700	7590	12/15/2003	EXAMINER DIAZ, JOSE R	
FARJAMI & FARJAMI LLP 16148 SAND CANYON IRVINE, CA 92618			ART UNIT 2815	

DATE MAILED: 12/15/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/590,462	RACANELLI ET AL	
	Examiner	Art Unit	
	José R Diaz	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If no period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06 November 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1, 2, 4-9, 17-22, 26-29 and 31-37 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1, 2, 4-9, 17-22, 26-29 and 31-37 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 June 2000 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
 a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

1. Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn. However, the claims are now rejected in view of Huisman et al. (US Pat. No. 5,854,117), Kasahara (US Pat. No. 4,868,134), IBM Corporation (NN79013241), and Wiedmann (US Pat. No. 3,770,519).

Drawings

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference characters "22A" and "22B" have been used to designate both active regions (see page 5, line 18) and a layer between FOX regions 21A, 21B and 21C, which seems to be an oxide layer. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference characters "111A" and "111B" have been used to designate both a "dual" nitride spacer (see fig. 11) and a single nitride spacer over a base oxide 71 (see fig. 12). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 1-2, 4-9, 17-22, 26-29, and 31-37 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claims 1, 9, 26, and 35, the limitations of forming a first implant having said first conductivity type and forming a second implant having said second conductivity type are confusing since it is not clear whether the terms first and second conductivity types refer to two regions having the same impurity types (e.g. two regions having either N- or P- type impurity) but different dopant concentrations (i.e. one region having P- and another P+) or two regions having different conductivity types (i.e. one region of N- type and another of P- type). Clarification is required.

Claims 2, 4-8, 17-22, 27-29, 31-34, and 36-37 are rejected due to their dependency on claims 1, 9, 26 and 35, respectively.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 1-2, 4, 6-7, 9, 17-18, 20-21, 26-29, 31 and 33-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huisman et al. (US Pat. No. 5,854,117) in view of Kasahara (US Pat. No. 4,868,134).

Regarding claims 1, 6, 9, 26, 33 and 35, Huisman et al. teaches a method of forming a varactor device on a semiconductor substrate, comprising the steps of: providing an epitaxial layer (2) situated in said semiconductor substrate (1) (see fig. 1), said semiconductor substrate (1) having a first conductivity type (N+) (see col. 4, lines 6-7) and said epitaxial layer (2) having a second conductivity type (N) (see col. 4, lines 7-8); providing an isolation structure (4) on said semiconductor substrate (1) (see fig. 1), said isolation structure (4) defining an implant region (see region between isolation structures 4) (see fig. 1), said implant region being situated over said epitaxial layer (2) (see fig. 1); forming a first implant (3) in said epitaxial layer (2) (see fig. 3) using said first implant energy (e.g. 70-80 KeV) (see "implantation energy" in Table 3), said first implant (3) having said second conductivity type (N) (see col. 6, lines 7-8), wherein said

first implant (3) extends into said epitaxial layer (2) a first distance (e.g. shallow first zone) (see fig. 3 and col. 4, line 64); forming a second implant (7) in said epitaxial layer (2) (see fig. 3) using a second implant energy (e.g. 80 KeV) (see col. 4, lines 45-46), said second implant having said second conductivity type (N) (see "Dopant atom" in Table 2), wherein said second implant (7) extends into said epitaxial layer (2) a second distance, wherein said second distance is greater than said first distance (please note that zone 7 is deeper than zone 3, see fig. 3).

However, Huisman et al. fails to teach the steps of selecting first and second peak dopant concentrations and first and second implant energies such that at least one of capacitance, leakage current, and tuning range of the varactor device is optimized. Kasahara teaches that it is well known in the art to form first and second implant regions (see curves (1) and (2) in fig. 3) having the second conductivity type (N) (see fig. 3) by selecting a first peak dopant concentration (see curve (a), having a maximum peak concentration at the depth X_1) (see fig. 3 and col. 4, lines 41-43) and a first implant energy (see col. 5, lines 62-63: "controlling the energy of ion-implantation") such that at least one of capacitance, leakage current, and tuning range of the varactor device is optimized (see col. 6, lines 39-40), and by selecting second peak dopant concentration (see curve (b), having a maximum peak concentration at the depth X_2) (see fig. 3 and col. 4, lines 50-53) and second implant energies (see col. 5, lines 62-63: "controlling the energy of ion-implantation").

In addition and with regards to claims 6, 9, 33 and 35, Kasahara further teaches that said second peak dopant concentration and said second implant energy are

selected with relation to said first peak dopant concentration and said first implant energy such that the base resistance of the varactor device is minimized (see col. 5, lines 59-67).

Huisman et al. and Kasahara are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to select first and second peak dopant concentrations and first and second implant energies such that at least one of capacitance, leakage current, and tuning range of the varactor device is optimized, and wherein said second peak dopant concentration and said second implant energy are selected with relation to said first peak dopant concentration and said first implant energy such that the base resistance of the varactor device is minimized. The motivation for doing so, as is taught by Kasahara, is to provide an improved variable-capacitance diode device in which sufficient tuning capacitance is available even with a low voltage (col. 2, lines 35-38). Therefore, it would have been obvious to combine Kasahara with Huisman et al. to obtain the invention of claims 1-2, 4, 6-7, 9, 17-18, 20-21, 26-28, 29, 31 and 33-37.

Regarding claims 2 and 29, Huisman et al. teaches the step of annealing the device following the steps of forming the first implant (3) (see "after-treatment temperature" in col. 5, lines 11-12) and second implant (7) (see "after-treatment temperature" in Table 2).

Regarding claims 4 and 31, Kasahara further teaches that the selecting step comprises determining an as-implanted dopant concentration profile for said first

implant (see figure 3, which shows the dopant concentration profile for the first implant region (curve 1) having a maximum peak concentration at depth X_1).

Regarding claims 7 and 34, Kasahara further teaches that the selecting step comprises determining an as-implanted dopant concentration profile for said second implant (see figure 3, which shows the dopant concentration profile for the second implant region (curve 2) having a maximum peak concentration A_5).

Regarding claims 17, 20, 27 and 36, Huisman et al. teaches the step of forming a contact layer (9) of said first conductivity type overlying said first implant (see fig. 5).

Regarding claims 18, 21, 28 and 37, Huisman et al. teaches that first and second conductivity types are the same (N) (see col. 4, lines 6-8).

9. Claims 5, 8 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huisman et al. (US Pat. No. 5,854,117) in view of Kasahara (US Pat. No. 4,868,134), and further in view of IBM Corporation (NN79013241), "Determination of Doping Profiles by Means of SIMS", IBM Technical Disclosure Bulletin, 1979, Vol. 21, Issue Number 8, p. 3241-3242.

Regarding claims 5, 8 and 32, a further difference between the prior art and applicant's invention is the use of secondary ion mass spectroscopy (SIMS) for determining the dopant concentration profile. However, IBM Corporation (NN79013241) teaches that SIMS is a well-known technique use for determining doping concentrations and their respective depth (see last sentence of the "DISCLOSURE TEXT").

Huisman et al., Kasahara and IBM Corporation (NN79013241) are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to determine the dopant concentration profile of the first and second implants by using secondary ion mass spectroscopy (SIMS). The motivation for doing so, as is taught by IBM Corporation (NN79013241), is determining the doping profile of the wafer (see lines 1-3 of the "DISCLOSURE TEXT"). Therefore, it would have been obvious to further combine IBM Corporation (NN79013241) with Huisman et al. and Kasahara to obtain the invention of claims 5, 8 and 32.

10. Claims 19 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huisman et al. (US Pat. No. 5,854,117) in view of Kasahara (US Pat. No. 4,868,134), and further in view of Wiedmann (US Pat. No. 3,770,519).

Regarding claims 19 and 22, a further difference between the prior art and applicant's invention is the step of providing a CMOS well as an isolation structure. Wiedmann teaches that is well known in the art to form CMOS well (4) as isolation structures.

Huisman et al., Kasahara and Wiedmann are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to providing an isolation structure comprising a CMOS well. The motivation for doing so, as is taught by Wiedmann, is isolating diodes from each other without requiring the allocation of

Art Unit: 2815

additional substrate space for isolation purposes (col. 2, lines 23-27). Therefore, it would have been obvious to further combine Wiedmann with Huisman et al. and Kasahara to obtain the invention of claims 19 and 22.

Response to Arguments

11. Applicant's arguments with respect to claims 1-2, 4-9, 17-22, 26-29, and 31-37 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Pfander et al. (US Pat. No. 3,581,164) discloses a varactor diode in figures 1 and 2; Aizuwakama (DE 30 34 287 A1) discloses a varactor diode in figure 2; and Nguyen et al. (US Pat. No. 5, 557, 140) discloses a bi-level capacitance varactor diode in figures 1 and 4.

Correspondence


13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to José R Díaz whose telephone number is (703) 308-6078. The examiner can normally be reached on 9:00-5:00 Monday, Tuesday, Thursday and Friday.

Art Unit: 2815

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (703) 308-2772. The fax phone number for the organization where this application or proceeding is assigned is (703) 308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

JRD


TOM THOMAS
SUPERVISOR EXAMINER